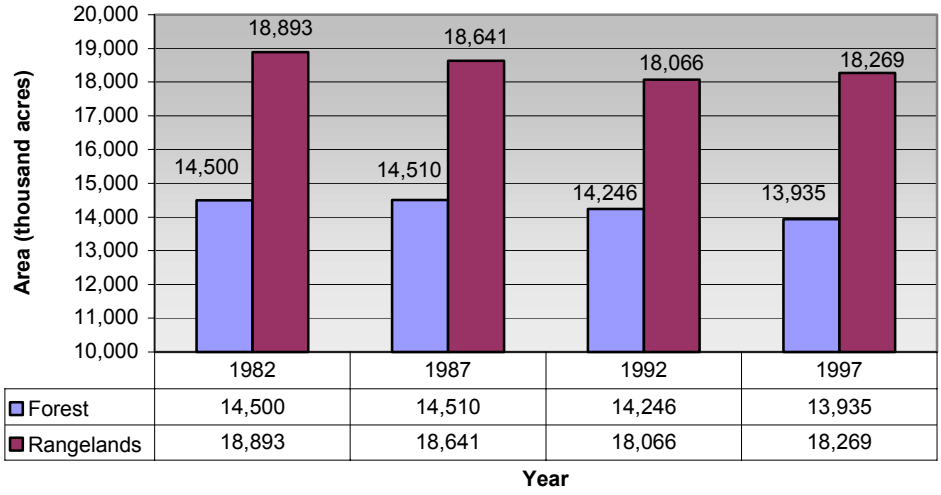
Findings on National Resource Inventory estimates of changes in forest and rangeland extent

The National Resource Inventory (NRI) is a compilation of natural resource information on non-federal lands in the United States. It is a ground-plot based inventory conducted by the NRCS in cooperation with Iowa State University. Data are collected every five years from the same sample sites. The information documented by the NRI reflects changes from all causes including urbanization, water projects, agriculture, and transfers to federal ownership.

NRI data show private forest and rangeland in California decreasing by approximately 1.2 million acres between 1982 to 1997 at an average rate of 79,000 acres per year (Figure 7).

Figure 7. Area of forests and rangelands (non-federal lands), 1982-1997



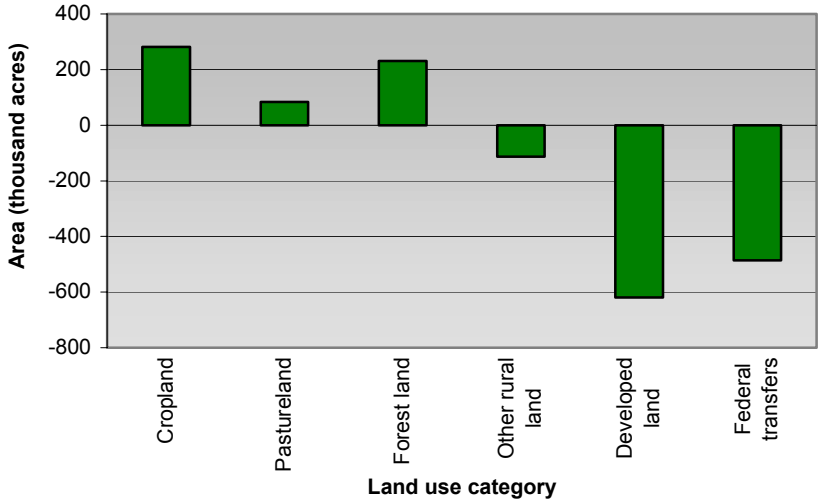
Source: NRCS, 2000

Types of changes to rangelands

Non-federal rangeland areas, mostly private lands, had a net decrease of approximately 624,000 acres between 1982 to 1997, an average rate of 42,000 acres converted to other uses or transferred per year (Figure 8). Other findings include:

- Approximately 733,000 acres converted to "Developed Land" or "Other Rural Land" categories describing urbanization.
- Approximately 487,000 acres transferred to federal ownership.
- Large areas of rangeland and agricultural land (Cropland and Pastureland) have interchanged during this period resulting in a net gain of over 365,000 acres from agricultural land categories.
- Over 231,000 acres converted from forest land to rangeland.

Figure 8. Change in NRI rangeland area to other land use categories, 1982-1997



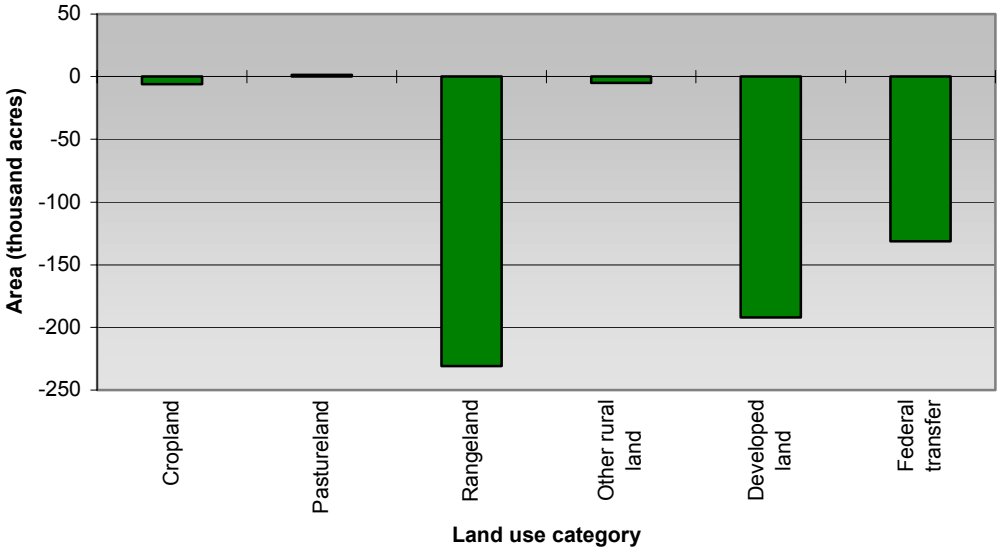
Source: NRCS, 2000

Types of changes to forest lands

On non-federal forest areas, mostly private lands, NRI data show a net decrease of approximately 564,000 acres between 1982 to 1997, an average rate of 38,000 acres converted to other uses or transferred per year (Figure 9). Other findings include:

- Nearly 200,000 acres converted to "Developed Land" or "Other Rural Land," categories describing urbanization. While this number is substantial, it is only 27 percent of the area of rangeland lost to development compared to rangeland conversion.
- Approximately 131,000 acres transferred to federal ownership.
- The largest change in forest land was the conversion to rangeland. Approximately 231,000 acres of forest land was reclassified as rangeland during the 15-year period.
- While some agricultural acreage reverted to rangeland, there seems to be almost no new land reverting from other uses into forest land.

Figure 9. Change in NRI forest land area to other land use categories, 1982-1997



Source: NRCS, 2000

NRI also reports changes in forests and rangelands by region (Table 2). The Mojave Basin shows the greatest change in rangeland, decreasing by nearly 470,000 acres between 1982 and 1997. As with al the NRI information, decreases reflect the combination of land conversion to developed uses and transfers to federal ownership. See the online document Major Land Resource Areas locations of the resource areas. Other regions with substantial decreases include the Southern California Coastal Plain and Central California Coast Range.

Table 2. Changes in non-federal forest and rangeland (thousand acres), 1982-1997

Major land resource area	Rangeland	Forest land	Total
4 - California Coastal Redwood Belt	(0.7)	(46.9)	(47.6)
5 - Siskiyou-Trinity Area	(31.0)	(55.6)	(86.6)
14 - Central California Coastal Valleys	57.1	(54.4)	2.7
15 - Central California Coast Range	(127.0)	16.5	(110.5)
16 - California Delta	(16.9)	0.0	(16.9)
17 - Sacramento and San Joaquin Valleys	(17.8)	(50.4)	(68.2)
18 - Sierra Nevada Foothills	72.6	(57.7)	14.9
19 - Southern California Coastal Plain	(250.0)	(62.7)	(312.7)
20 - Southern California Mountains	76.1	(104.4)	(28.3)
21 - Klamath and Shasta Valleys and Basins	8.9	(17.3)	(8.4)
22 - Sierra Nevada Range	151.9	(158.4)	(6.5)
23 - Malheur High Plateau	10.5	(9.5)	1.0
26 - Carson Basin and Mountains	1.0	4.4	5.4
29 - Southern Nevada Basin and Range	(84.8)	34.7	(50.1)
30 - Mojave Basin and Range	(470.1)	(2.9)	(473)
31 - Imperial Valley	(4.0)	0.0	(4.0)
Total California changes in rangeland and forest land 1982-1997	(624.2)	(564.6)	(1,188.8)

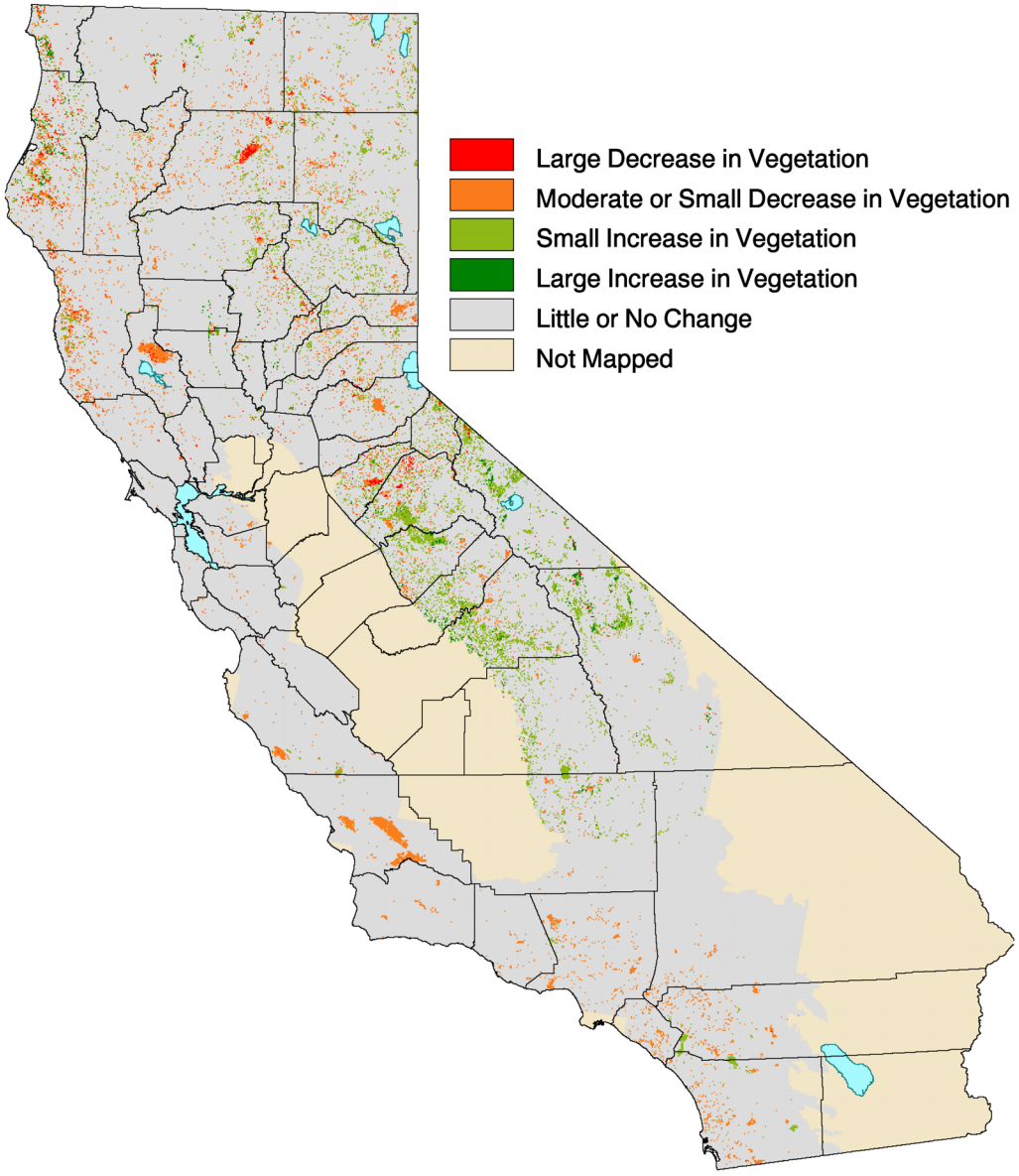
Note: decreases expressed in parentheses

Source: NRCS, 2000

Changes in forest and rangeland canopy cover recorded by the California Land Cover Mapping and Monitoring Program

To monitor ongoing changes to vegetation, CDF and the USFS developed the California Land Cover Mapping and Monitoring Program (LCMMP), a cooperative program to measure and map changes in vegetation cover. The program measures both increases and decreases in "canopy cover," or the horizontal area that trees occupy. As such, it provides a spatial and statistical view over time of the change in continuity and density of tree and shrub vegetation on the California landscape (Figure 10). See the Assessment document Assessment Information Systems for a description of LCMMP.

Figure 10. Locations of detected canopy cover changes in California forest and rangeland for five-year monitoring periods, 1990-1998



Source: FRAP, 2002b

Changes in forest canopy

Approximately 90 to 99 percent of all forest and rangeland areas had no detectable change.

Results for all LCMMP project areas show the vast majority of forests and rangelands remained unchanged during the monitoring periods. Approximately 90 to 99 percent of all forest and rangeland areas showed little to no change. Just over 195,000 acres showed "moderate or large decreases" in canopy cover within the Southern Sierra and Northeastern project areas and nearly 259,000 acres within the South Coast and North Coast (Tables 3 and 4).

Table 3. Forest and rangeland classified change, Southern Sierra and Northeastern** California Land Cover Mapping and Monitoring Program project areas, Cycle 1 (thousand acres)

	Southern Sierra, 1990-1995		Northeastern, 1991-1996	
Change group	Area	Percentage of total forest and rangeland area	Area	Percentage of total forest and rangeland area
Large decrease in vegetation cover	20	<1	35	<1
Moderate decrease in vegetation cover	59	<1	83	1
Small decrease in vegetation cover	139	1	358	2
Little to no change in vegetation cover	12,194	87	13,711	93
Small increase in vegetation cover	833	6	511	3
Moderate increase in vegetation cover	198	1	56	<1
Large increase in vegetation cover	44	<1	3	<1
Other non-vegetation change*	591	4	66	<1
Total	14,077	100	14,822	100

**Includes clouds, shadow, and change in water or snow level*

***Includes parts of Cycle 2 regions, Cascade Northeast and Northern Sierra*

Source: FRAP, 2002b

Table 4. Forest and rangeland classified change, South Coast and North Coast California Land Cover Mapping and Monitoring Program project areas, Cycle 1 (thousand acres)

	South Coast, 1993-1997		North Coast, 1994-1998	
Change group	Area	Percentage of total forest and rangeland area	Area	Percentage of total forest and rangeland area
Hardwood and conifer				
Large decrease (71 to 100 percent)	1	<1	20	<1
Moderate decrease (41 to 70 percent)	15	<1	51	<1
Small decrease (16 to 40 percent)	24	<1	110	1
Little or no change (+15 to -15 percent)	16,152	98	14,065	95
Small increase (16 to 40 percent)	1	<1	61	<1
Moderate to large increase (41 to 100 percent)	(L)	<1	12	<1
Shrub and grass				
Shrub and grass decrease > 15 percent	162	1	12	<1
Shrub and grass increase > 15 percent	34	<1	14	<1
Other non-vegetation change*	75	<1	467	3
Total	16,463	100	14,812	100

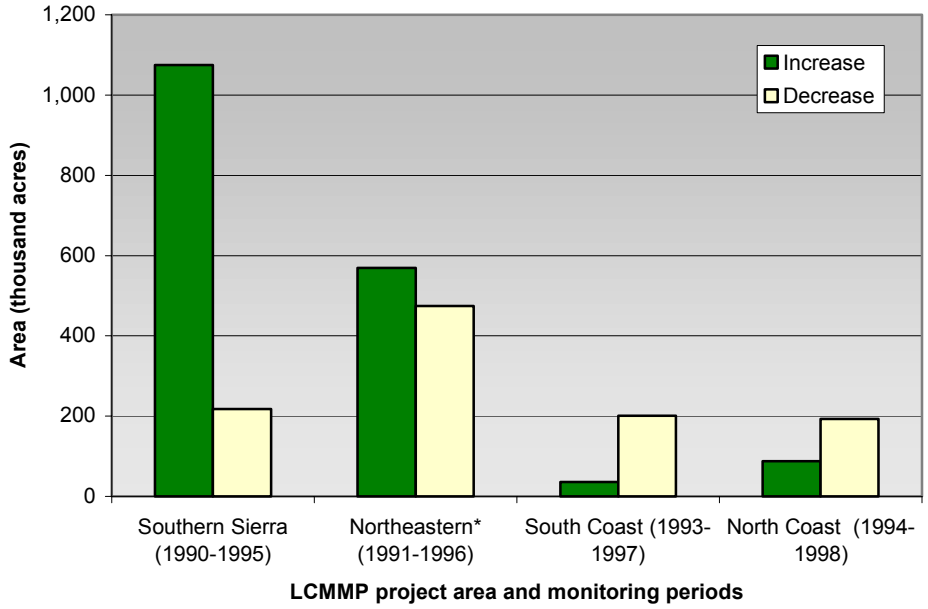
L – Less than 500 acres

**Includes clouds, shadow, and change in water or snow level*

Source: FRAP, 2002b

Acres with increases in forest and rangeland cover exceeded decreases in the Southern Sierra and Northeastern project areas; however, decreases exceed increases in the South and North Coast project areas. In terms of total acres, the Northeastern project area had 475,000 acres that showed a decrease, the largest forest and rangeland acreage with decreased canopy among all areas. Most of this was recorded as a small decrease in vegetation cover. At the same time, the total increase in vegetation cover was 570,000 acres. All other project areas had nearly the same forest and rangeland acreage with canopy decreases ranging from 193,000 to 218,000 acres (Figure 11).

Figure 11. Forest and rangeland vegetation change by California Land Cover Mapping and Monitoring Program project area during five-year monitoring periods



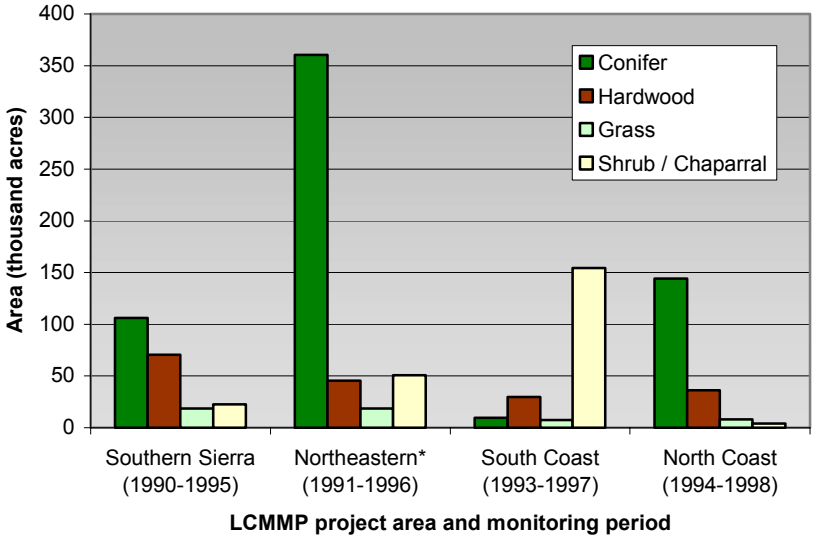
**Includes part of Cascade Northeast and Northern Sierra due to project area boundary change between cycles 1 and 2*

Source: FRAP, 2002b

Change by vegetation type

The LCMMP monitors forest and rangeland land cover classes and their associated California Wildlife Habitat Relationship (CWHR) system habitat types. Of major land cover types, conifer had the greatest acreage of cover decrease Statewide. By project area, the Southern Sierra, Northeastern, and North Coast had the greatest acreage of cover decrease in the conifer land cover class, while the South Coast had the greatest area of cover decrease in the Shrub class (Figure 12). Hardwoods decreased evenly across all regions, ranging from 30,000 to 70,000 thousand acres. Grassland decreases were minor. For a detailed description of forest and rangeland vegetation change by CWHR habitat type and region, see the Monitoring Land Cover Changes in California web page.

Figure 12. Area of forest and rangeland cover decrease by land cover class and California Land Cover Mapping and Monitoring Program project area during five-year monitoring periods



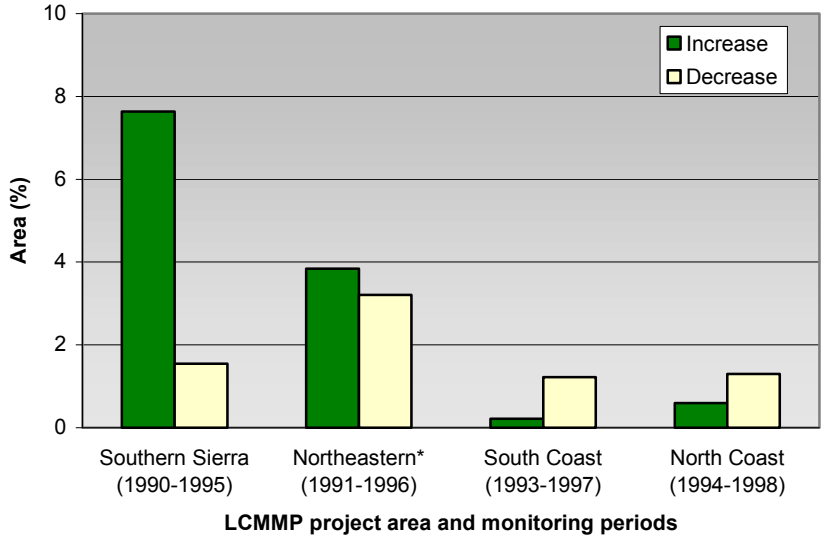
**Includes part of Cascade Northeast and Northern Sierra due to project area boundary change between cycle 1 and 2*

Source: FRAP, 2002b

The Northeastern project area experienced the greatest proportional area of cover decrease among all project areas (475,122-acres, 3.2 percent) (Figure 13). All other project areas had areas of cover decrease ranging from 29,000 to 218,000 acres. These changes affected approximately 1.2 to 1.5 percent of each area's total forest and rangeland area.

Changes in total forest and rangeland vegetation were most dominant in the Southern Sierra (Figure 14). This project area showed a 13 percent detected hardwood cover increase. This is primarily due to re-growth of hardwoods, shrubs, and grasses following a large fire.

Figure 13. Percentage area of total forest and rangeland vegetation with canopy change by project area during the five-year monitoring periods

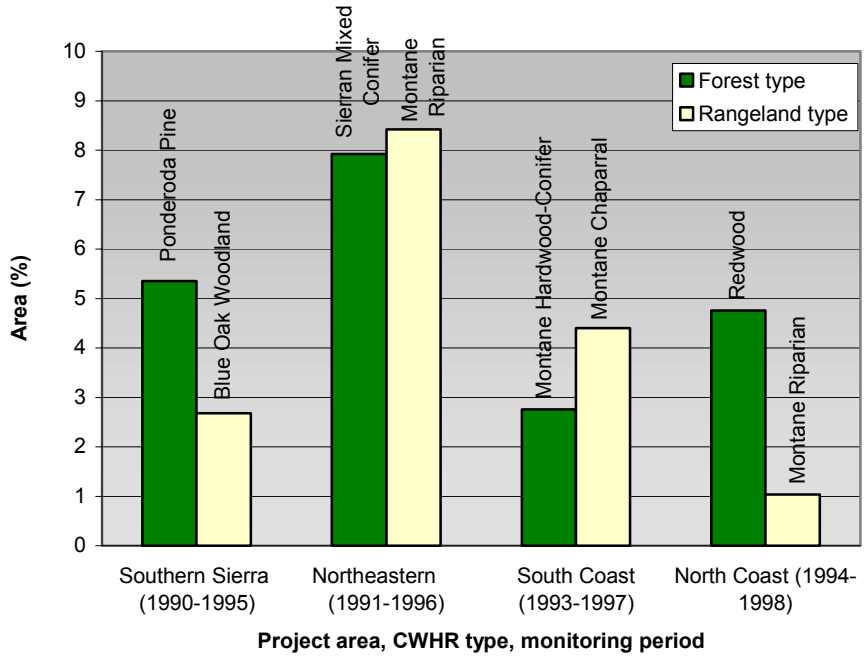


**Includes part of Cascade Northeast and Northern Sierra due to project area boundary change between cycle 1 and 2*

Source: FRAP, 2002b

Cover decreases for the more detailed forest and rangeland CWHR types are shown in Figure 14. Sierran Mixed Conifer and Ponderosa Pine recorded the greatest proportional change of all the conifer vegetation types (Figure 14). The Sierran Mixed Conifer habitat type in the Northeastern project area had the largest proportional area with a decrease, 7.9 percent or 238,000 acres.

Figure 14. Percentage area of forest and rangeland CWHR type with the largest cover decrease by California Land Cover Mapping and Monitoring Program project area during five-year monitoring periods



**Includes part of Cascade Northeast and Northern Sierra due to project area boundary change between cycle 1 and 2*

Source: FRAP, 2002b

Change by cause

Determining the cause of vegetation change is another component of the LCMMP. Larger change areas (greater than 25 acres) are more readily attributed compared to smaller ones (2.5 to 10 acres). Cause was identified on 49,000 acres of forest and rangeland with vegetation decrease (20 percent verified) in the Southern Sierra project area, while 295,000 acres (87 percent verified) were identified in the Northeastern, 36,000 acres (91 percent verified) in the South Coast, and 131,000 acres (73 percent verified) in the North Coast.

Where cause of change has been verified, fire and harvest were the main agents of change within all project areas. Within the Southern Sierra project area, fire was the catalyst for 13 percent of verifiable area decrease while harvesting contributed six percent (Figure 15a). Harvest constituted 35 percent of verifiable change within the Northeastern project area while fire contributed to 47 percent (Figure 15b). The South Coast had 92 percent of verifiable change attributable to fire (Figure 15c). Harvesting (27 percent) and fire (36 percent) constituted the majority of verifiable change within the North Coast (Figure 15d). For a more detailed description of vegetation change by cause and region, see the Monitoring Land Cover Changes in California web page.

Figure 15. Percentage area of forest and rangeland vegetation change by cause

Figure 15a. Southern Sierra project area, 1990-1995

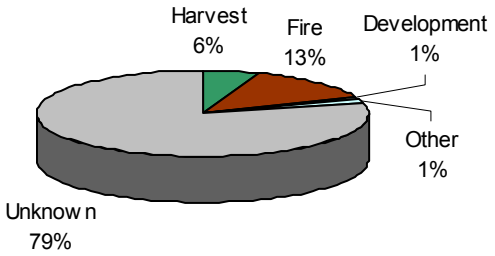


Figure 15b. Northeastern project area, 1990-1995

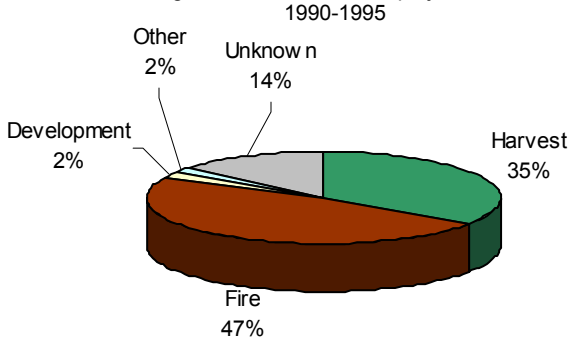


Figure 15c. South Coast project area, 1990-1995

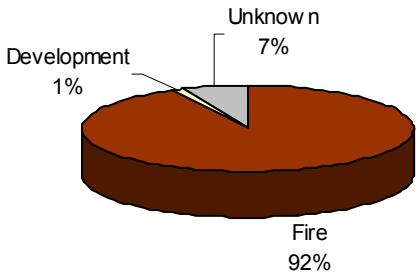
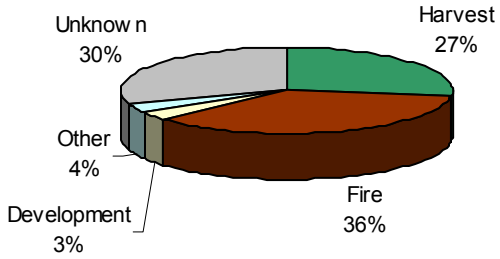


Figure 15d. North Coast project area, 1990-1995



Source: FRAP, 2002b

Changes due to development are a relatively small fraction of total change, but are the most permanent. All observed decreases and increases in cover attributed to development, regardless of the change group (large, moderate, or small decreases and increases), represent more permanent alterations to wildland habitat conditions. Development is detected as an increase or decrease depending on when the detected change occurs. Decreases are detected when the land is cleared and increases are detected when landscape vegetation is planted and irrigated.

County area decreases by verifiable cause: County analysis of the change detection information reveals different patterns of cause driven by activities specific to the region and the county.

Harvesting: In Lassen County, harvesting is a leading cause of forest and rangeland cover change. Harvesting includes removal of live or dead trees for wood products, thinning to promote improved growth conditions for trees, and fuel break construction for fire hazard reduction. Harvesting or land clearing activities that support silvicultural or fire hazard reduction objectives resulted in over 70 percent (48,751 acres) of change area in Lassen County's forest and rangeland canopy (Figure 16).

Fire: In Monterey County, fire, including prescribed burning, was the dominant agent of change in forest and rangeland canopy cover. About 93 percent (10,410 acres) of change in Monterey County area was attributed to fire (Figure 17).

Development: In rapidly growing Butte County, development for residential or commercial use was a major cause of change in forest and rangeland cover. Approximately 15 percent (3,536 acres) of verified change in Butte County was attributed to development (Figure 18).

See the online document Forest and Rangeland Vegetation Decrease by Cause in All Counties for profiles of causes of change in forests and rangelands for every county.

Figure 16. Percentage area of forest and rangeland vegetation decrease by cause, Lassen County (excludes grass and shrub), 1994-1998

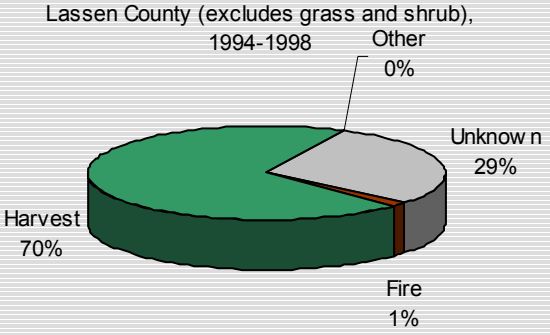


Figure 17. Percentage area of forest and rangeland vegetation decrease by cause, Monterey County, 1994-1998

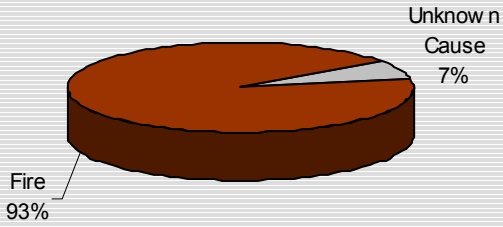
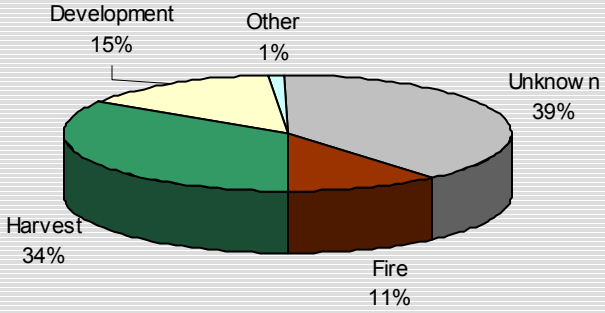


Figure 18. Percentage area of forest and rangeland vegetation decrease by cause, Butte county, 1991-1996

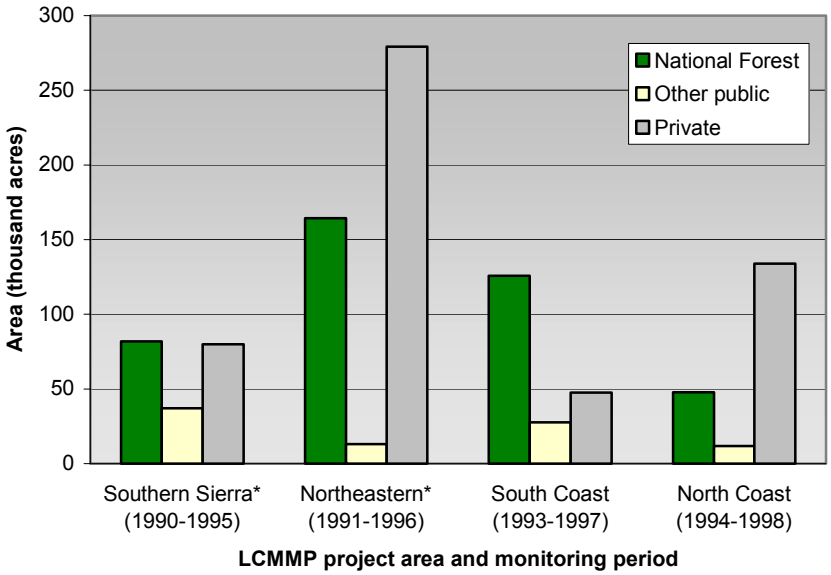


Source: FRAP, 2002b

Change by ownership

The LCMMP also documents canopy cover change area by ownership. The greatest extent of forest and rangeland area showing a decrease in canopy cover occurred on private ownerships within the Northeastern and North Coast project areas (Figure 19). In the South Coast and Southern Sierra project areas, forests and rangelands on national forests had the largest area of decreases among all ownerships. Overall, privately owned forests and rangelands in the Northeastern project area had the greatest extent of forest and rangeland canopy decrease of all ownership groups in all regions. For more detailed summaries of forest and rangeland canopy cover change by ownership, see the Monitoring Land Cover Changes in California web page.

Figure 19. Area of forest and rangeland vegetation decrease by ownership and project area during five-year monitoring periods



**Includes part of Cascade Northeast and Northern Sierra due to project area boundary change between cycle 1 and 2*

Source: FRAP, 2002b

Conclusion on forest and rangeland cover change findings

The LCMMP found that the vast majority of California's forests and rangelands had only slight measurable changes in cover during the monitoring periods. However, over 200,000 acres of forests and rangelands in California experienced some level of alteration resulting in a vegetation cover decrease. Both natural (fire and pests) and human disturbances (timber harvesting, development, and agricultural clearing) caused these changes. Wildfire and harvesting were found to be major causes of vegetation change.

Focusing on the location and habitat types most impacted helps provide direction for further analysis of vegetation changes. Conifer forests in the Northeastern and North Coast represent the land cover with the most total area impacted. Shrub vegetation in the South Coast project area also had large total impacts.

Glossary

BLM: U.S. Bureau of Land Management.

California Wildlife Habitat Relationship: The California Wildlife Habitat Relationship system is a state-of-the-art classification system for California's wildlife. CWHR contains life history, management, and habitat relationships information on 675 species of amphibians, reptiles, birds, and mammals known to occur in the State. CWHR products are available for purchase by anyone interested in understanding, conserving, and managing California's wildlife.

CDF: California Department of Forestry and Fire Protection.

CRP: Conservation Reserve Program.

CWHR: See **California Wildlife Habitat Relationship**.

development: A human settlement pattern having a density of more than one housing unit per 20 acres.

Developed Land: An NRI definition comprises large urban and small built-up areas, as well as roads and railroads not included in urban/built-up areas.

Forest land: An NRI definition comprising a land cover /use category that is at least 10 percent stocked by single-stem woody plant species of any size that will be at least 4 meters tall at maturity.

Forest and Rangeland Renewable Resources Planning Act of 1974: An assessment of the nation's renewable resources every 10 years conducted by the US Forest Service.

FRAP: Fire and Resource Assessment Program.

FRAPVeg: Fire and Resource Assessment Program Vegetation Habitat Classification and Mapping Project, multi-source vegetation data.

land cover: Predominant vegetation life forms, natural features, or land uses that occupy a land area.

LCMMP: Land Cover Mapping and Monitoring Program.

Montreal Process: A scientifically rigorous set of criteria and indicators used to measure forest management and sustainability.

NFS: National Forest System.

NPS: National Park Service.

NRCS: U.S. Natural Resources Conservation Service.

NRI: National Resource Inventory.

Other Rural Land: An NRI definition comprising land cover /use category that includes farmsteads and other farm structures, field wind breaks, barren land and marshland.

overstory: The larger, taller trees that occupy a forest area and shade young trees, hardwoods, brush, and other deciduous varieties growing beneath the larger trees (i.e., understory).

Rangeland: Any expanse of land not fertilized, cultivated or irrigated that is suitable, and predominately used for, grazing by domestic livestock and wildlife. These include the Conifer Woodland, Hardwood Woodland, Shrub, Grassland, Desert land cover types along with some habitats within the Wetland and Hardwood Forest land cover classes.

RPA: See **The Forest and Rangeland Renewable Resources Planning Act of 1974**.

silviculture: Generally, the science and art of cultivating (such as with growing and tending) forest crops, based on the knowledge of silvics. More explicitly, silviculture is the theory and practice of controlling the establishment, composition, constitution, and growth of forests.

USDA: U.S. Department of Agriculture.

USFS: U.S. Forest Service.

Literature cited

Atwood, J.L. 1990. Status review of the California gnatcatcher (*Polioptila californica*). Unpublished Technical Report. Manomet, MA: Manomet Bird Observatory.

Bolsinger, C.L. 1988. The hardwoods of California's timberlands, woodlands, and savannas. Resource Bulletin PNW-RB-148. Portland, OR: U.S. Forest Service.

California Department of Fish and Game. 1991. The 1990 annual report on the status of California's state listed threatened and endangered plants and animals. Sacramento, CA.

Doyle, Kevin, John Kostyack, Ben McNitt, Glen Sugameli, Caron Whitaker, Kenneth Whitcomb-Blaylock, Julia Byrd, and Greg Stull. 2001. Paving paradise: sprawl's impact on wildlife and wild places in California, a smart growth and wildlife campaign white paper. National Wildlife Federation. Web site accessed February 26, 2003. http://www.nwf.org/smartgrowth/pdfs/pages1-17.pdf.

Fire and Resource Assessment Program (FRAP). 2001. Development and vegetation trends. Sacramento, CA. Web site accessed February 26, 2003. http://frap.cdf.ca.gov/projects/development_vegetation/index.html.

Fire and Resource Assessment Program (FRAP). 2002a. Multi-source Land Cover, v02_1. Sacramento, CA. http://frap.cdf.ca.gov/projects/frapgisdata/select.asp

Fire and Resource Assessment Program. 2002b. Land Cover Mapping and Monitoring program. Sacramento, CA. Web site accessed February 26, 2003. http://frap.cdf.ca.gov/projects/land_cover/monitoring/index.html.

Fire and Resource Assessment Program (FRAP). 2003. Census 2000 Block Groups (Migrated), v03_1. Sacramento, CA. http://frap.cdf.ca.gov/data/frapgisdata/select.asp.

Fire and Resource Assessment Program (FRAP). 2003b. Development Projections (Census 2000), v03_1. Sacramento, CA. http://frap.cdf.ca.gov/data/frapgisdata/select.asp.

Fire and Resource Assessment Program (FRAP). 2003c. Footprint of Development (Census 2000), v03_1. Sacramento, CA. http://frap.cdf.ca.gov/data/frapgisdata/select.asp.

Freas, K.E. and D.D. Murphy. 1988. Taxonomy and the conservation of the critically endangered Bakersfield saltbush, *Atriplex tularensis*. Biological Conservation 46:317-324.

Holland, R. 1978. The geographic and edaphic distribution of vernal pools in the Great Central Valley, California. Special Publication 4. Sacramento, CA: California Native Plant Society.

Kreissman, B. 1991. California, an environmental atlas and guide. Davis, CA: Bear Klaw Press.

Mayer, K.E. and W.F. Laudenslayer, Jr. (editors). 1998. A guide to wildlife habitats of California. Sacramento, CA: California Department of Fish and Game and California Department of Forestry and Fire Protection.

McBride, Joe R., William Russell, and Sue Kloss. 1996. Impact of human settlement on forest composition and structure. In: Centers for Water and Wildland Resources. 1996. Sierra Nevada Ecosystem Project, final report to Congress, vol. II, assessments and scientific basis for management options. Davis, CA: University of California.

Natural Resources Conservation Service. 2000. 1997 National Resources Inventory summary report. Web site accessed February 26, 2003. http://www.nrcs.usda.gov/technical/NRI/1997/summary_report/.

Noss, Reed F., Edward T. LaRoe, and J. Michael Scott. 1995. Endangered ecosystems of the United States: A preliminary assessment of loss and degradation. Biological Report 28. U.S. Geological Survey.

O'Leary, J.F. 1990. California coastal sage scrub: general characteristics and considerations for biological conservation. In: Schoenherr, A.A. (editor). Endangered plant communities of Southern California. Special Publication 3. pp. 24-41. San Diego, CA: Southern California Botanists.

Smith, W.B., J.S. Vissage, R. Sheffield, and D.R. Darr. 2001. Forest resources of the United States, 1997. General Technical Report NC-219. St. Paul, MN: U.S. Forest Service, North Central Research Station.

U.S. Fish and Wildlife Service. 1992. Proposed listing rule for California gnatcatcher (*Polioptila californica*). Portland, OR.